

**WHAT IS CLAIMED IS:**

1. A system for visually displaying real-time enterprise status information related to a status of jobs running on machines, comprising:
  - an application integration platform that receives said real-time enterprise status
- 5 information and analyzes said information to determine at least one key performance indicator;
  - a process control server that receives status information from at least one work center and forwards said status information to said application integration platform;
  - a database containing information related to manufacturing processes performed at said at least one work center; and
- 10 a graphical user interface that interfaces with said application integration platform to provide a visual display of said at least one said key performance indicator,
  - wherein a said system provides for minimizing the number of tardy jobs running on machines within said at least one work center.
- 15 2. The system recited in claim 1, wherein jobs are initially scheduled on said machines and wherein said system provides for control of scheduling after jobs are released to the work center shop floor.
- 20 3. The system of claim 2, wherein jobs are rescheduled from one machine to another in accordance with an expected completion time.
- 25 4. The system of claim 3, wherein said expected completion time is determined based on an average completion time for a set of jobs assigned to said machines plus a total variation for all jobs in said machines.
5. The system recited in claim 1, wherein said system graphically presents scheduled jobs for each machine and an expected completion time, wherein said expected completion time includes any tardiness.
- 30 6. The system recited in claim 5, wherein a maximum number of tardy jobs is defined as:  
$$\text{Max}\{d_i - E_{\text{es}} < 0\},$$
$$i \in K$$

$m \in M$   
wherein

$$Em = T_c + \sum_{i=1}^k \mu_i + Z_{\alpha/2} \sigma_{1..k}$$

and wherein

- 5       $d_i$  = Due date for job i
- $E_m$  = Expected completion time of the jobs on machine m
- $M$  = Machine set
- $K$  = Set of jobs scheduled on selected machine
- $z_\alpha$  = Standard normal distribution coefficient for given risk,  $\alpha$
- 10      $\sigma_i$  = Standard deviation for a particular job in machine M
- $\mu_i$  = Average duration for a particular job in machine M
- $T_c$  = Current time.

- 7. The system recited in claim 5, wherein an expected completion time for a set of jobs is  
15 defined by:

$$\min_{j=1}^M \left\{ T_c + \sum_{i=1}^k \mu_i + z_{\alpha/2} \sigma_{mT} \right\}$$

where

$$\sigma_{mT} = \sqrt{\sigma_1^2 + \sigma_2^2 + \dots + \sigma_n^2}$$

Where

- 20      $M$  = Machine set
- $K$  = Set of jobs scheduled on selected machine
- $z_\alpha$  = Standard normal distribution coefficient for given risk,  $\alpha$
- $\sigma_{mT}$  = Total standard deviation for set of jobs in machine m
- $\mu_i$  = Average duration for a particular job in machine M
- 25      $T_c$  = Current time

- 8. The system of claim 1, wherein an uncertainty level is assigned based on an expected completion time for jobs, said uncertainty time being a time within which it is expected that a predetermined percentage of said jobs will be completed.

9. A system for visually displaying real-time enterprise management information, comprising:

an application integration platform that receives plural types of data from manufacturing and information systems within an enterprise via a network infrastructure and analyzes said plural types of data in response to user inputs to determine a level of tardiness of jobs running on manufacturing machines;

5 a process control server that receives manufacturing data from at least one work center and forwards said manufacturing data to said application integration platform;

10 a database containing information related to manufacturing processes performed at said at least one work center; and

a user interface that displays the analyzed plural types of data, one of said plural types of data being job tardiness,

15 wherein said at least one work center contains said manufacturing machines, and a controller that receives sensor data from said machines and communicates said sensor data to said process control server.

10. The system recited in claim 9, wherein jobs are rescheduled from one machine to another in accordance with an expected completion time, and said expected completion time is determined based on an average completion time for a set of jobs assigned to said machines plus a total variation for all jobs in said machines.

20 11. The system recited in claim 9, wherein said system graphically presents scheduled jobs for each machine and an expected completion time, wherein said expected completion time includes any tardiness.

25 12. The system of claim 9, wherein an uncertainty level is assigned based on an expected completion time for jobs, said uncertainty time being a time within which it is expected that a predetermined percentage of said jobs will be completed.

13. The system recited in claim 9, wherein differing levels of information are provided to different classes of users, said classes of users include managers, engineers, and operators.

14. A method of visually displaying real-time enterprise management information, said  
5 method comprising:

obtaining manufacturing data from at least one work center having at least one manufacturing machine;

storing said manufacturing data in a database containing information related to manufacturing processes performed at said at least one work center;

10 analyzing said manufacturing data to determine jobs that are tardy; and presenting job status to users in a manner to indicate tardy jobs.

15. The method of claim 14, further comprising:

initially scheduling jobs on said machines in accordance with a predetermined  
15 methodology; and

rescheduling jobs after jobs are released to the work center shop floor to reduce a number of said tardy jobs.

16. The method of claim 15, wherein jobs are rescheduled from one machine to another  
20 in accordance with an expected completion time.

17. The method of claim 16, wherein said expected completion time is determined based on an average completion time for a set of jobs assigned to said machines plus a total variation for all jobs in said machines.

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18. The method recited in claim 14, comprising:

presenting scheduled jobs graphically for each machine, said graphical presentation including an expected completion time, wherein said expected completion time includes any tardiness.

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19. The method recited in claim 18, further comprising determining a maximum number of tardy jobs in accordance with:

$$\text{Max}\{d_i - E_m < 0\}$$

$$i \in K$$

$$m \in M$$

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wherein

$$E_m = T_c + \sum_{i=1}^k \mu_i + Z_{\alpha/2} \sigma_{i,k}$$

and wherein

$d_i$  = Due date for job i

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$E_m$  = Expected completion time of the jobs on machine m

M = Machine set

K = Set of jobs scheduled on selected machine

$Z_\alpha$  = Standard normal distribution coefficient for given risk,  $\alpha$

$\sigma_i$  = Standard deviation for a particular job in machine M

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$\mu_i$  = Average duration for a particular job in machine M

$T_c$  = Current time.

20. The method recited in claim 18, further comprising determining an expected completion time by:

$$\text{Min}_{j=1}^M \left\{ T_c + \sum_{i=1}^k \mu_i + Z_{\alpha/2} \sigma_{mT} \right\}$$

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where

$$\sigma_{mT} = \sqrt{\sigma_1^2 + \sigma_2^2 + \dots + \sigma_n^2}$$

Where

M = Machine set

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K = Set of jobs scheduled on selected machine

$Z_\alpha$  = Standard normal distribution coefficient for given risk,  $\alpha$

$\sigma_{mT}$  = Total standard deviation for set of jobs in machine m

$\mu_i$  = Average duration for a particular job in machine M

$T_c$  = Current time

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21. The method of claim 14, further comprising assigning an uncertainty level based on an expected completion time for jobs, said uncertainty time being a time within which it is expected that a predetermined percentage of said jobs will be completed.